

REPLACEMENT
PART 34 AMDT
10/501466

CLAIMS

1. Method for determining the penetration rate of a gaseous substance into a closed package made of a package material,
characterised in that the method comprises:
 - 5 - flushing the package with an inert gas for a sufficiently period to ensure that the interior of the package contains only small amounts of the gaseous substance, and then seal off the package against the ambient atmosphere,
 - exposing the closed package to ambient atmosphere containing a known quantity of the gaseous substance for a first specified time period,
 - 10 - when reaching the end of the first time period, determine a first concentration of the gaseous substance within the package at the end of the first time period,
 - allowing the package to be exposed to the ambient gas for a second time period,
 - when reaching the end of the second time period, determine a second concentration of the gaseous substance within the package at the end of the second
 - 15 time period, and
 - employ the two measured concentrations of the gaseous substance in Eqn. (5) to predict the penetration rate of the gaseous substance into the closed package as a function of time.
2. Method according to claim 1,
20 characterised in that the gaseous substance is oxygen, and that the inert gas is pure nitrogen.
3. Method for determining the penetration rate of a oxygen into a closed package, characterised in that the method comprises:
 - inserting means for withdrawing a gas sample from the package in such a manner
 - 25 that the interior of the package is not exposed to ambient gas (outside the package),
 - flushing the package with pure nitrogen for a sufficiently period to ensure that the interior of the package contains only little oxygen,
 - exposing the closed package to ambient for a first specified time period,
 - 30 - when reaching the end of the first time period, inserting a specified amount of pure nitrogen gas into the package and allowing the inserted nitrogen to mix homogeneously with the gas inside the package,
 - when the gas inside the package is homogeneously mixed, withdraw a gas sample
 - 35 with exactly the same volume as the inserted nitrogen, and analyse the gas sample from the interior in order to determine the concentration of the oxygen in the sample after the first time period,
 - allowing the package to be exposed to the ambient air for a second time period,
 - when reaching the end of the second time period, withdraw another sample of the

gas from the inside of the package and analyse it in order to determine the oxygen concentration in the sample after the second time period, and

- insert the two measured oxygen concentrations in Eqn. (5) and/or Eqn. (7) to predict the oxygen transmission rate into the package.

- 5 4. Method for performing spot tests to evaluate the penetration rates of a oxygen into an empty closed package in relation to a reference value, characterised in that the method comprises:

1) in the case where the reference value is not available:

- 10 - establish a set of reference values of the oxygen transmission rate for all times by performing a series of screening tests of packages made of the same material and which has equal dimensions as the said package for a set of conditions the package is expected to meet in commercial handling by employing the method as given in claim 2 or 3, except that the oxygen transmission rates should be given as the resulting oxygen concentration inside the package (employ Eqn. (3) instead of (5)),
- 15 - perform spot testing of the said package, where the spot testing involves to first flush the empty package with inert gas such that practically all of the said gaseous substance is removed, leaving the package to be exposed to the ambient atmosphere for a certain time period, and then determine the oxygen concentration of the said empty package, and

- 20 - compare the determined said oxygen concentration after the time period with the reference value to determine whether the oxygen transmission rates of the said package are equal to the reference packages, or

2) in the case reference values are available:

- 25 - perform spot testing of the said package, where the spot testing involves to first flush the empty package with inert gas such that practically all of the said gaseous substance is removed, leaving the package to be exposed to the ambient atmosphere for a certain time period, and then determine the oxygen concentration of the said empty package, and
- 30 - compare the determined said oxygen concentration after the time period with the reference value to determine whether the oxygen transmission rates of the said package are equal to the reference packages.

5. Method according to any of claims 1-4, characterised in that the package is a food package or a pharmaceutical package.

- 35 6. Device for determining the penetration rate of a oxygen into a closed package, characterised in that it comprises:
- a source of pure inert gas,
 - an injector which is capable of inserting and withdrawing gas samples to/from the interior of a package, and optionally to initially flush the interior of the package with the inert gas in order to remove almost all oxygen inside the package, without

exposing the interior of the package to the ambient atmosphere,

- an oxygen analyser that is capable of determining the oxygen concentration of the withdrawn gas sample, and

5 - computer software and hardware that is able to calculate and display the oxygen transmission rates as a function of time from two measured oxygen concentrations.

7. Device for determining spot tests of the penetration rate of a gaseous substance into a closed package, where the package that is being tested is initially flushed with inert gas, sealed, and then exposed to the ambient atmosphere for a certain time period,

10 characterised in that it comprises:

- an injector which is capable of withdrawing a gas samples from the interior of the package,

- a gas analyser that is in communication with the injector and which determines the concentration of the gaseous substance, and

15 - means for displaying the resultant gas concentration.

8. Device according to claim 6,

characterised in that the gaseous substance is oxygen, and that the inert gas is pure nitrogen.

9. Device according to claims 6 or 7,

20 characterised in that the device further comprises:

- computer hardware that is in communication with the gas analyser, and which is able to memorise a set of predetermined reference values of the transmission rates as a function of time for different ambient conditions,

25 - computer software incorporated into the computer hardware that is able to register the measured gas concentration directly from the gas analyser and then compare it with the reference values, and

- displaying means that is able to display the comparison between the actually determined and the reference value of the gas concentration.